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FAST-TRACKING CLIMATE CHANGE MITIGATION STRATEGIES

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ABSTRACT

The United Nations Framework Convention on Climate Change (UNFCCC) strategies and techniques for climate change mitigation adopted and implemented around the world is not making any significant impact in Yobe State (located in north-eastern Nigeria). A survey was carried out and data was collected by means of administering 400 Questionnaires (Qs.) between the period of March, 2017 and September, 2018. Out of the 400 survey instruments that were distributed, 305 completed Qs were returned, some were invalid and others were not returned. Subsequently, most of the respondents believe that the strategies are effective. However, the results does not reflect the true situation on ground. That is, the kind of policies been formulated in the state, and the kind of programmes and development that does not have any evidence of adherence to existing climate change mitigation strategies. The authors were able to measure the level of understanding of the residents with regard to the effectiveness of the strategies. Despite the wide-ranging publicity by the media, the huge amount of resources spent and dedicated to climate change mitigation by the authorities, the study could change the way Carbon dioxide (CO2) emission is been managed. This is the first study that tested the effectiveness of UNFCCC climate change mitigation strategies at the study area.

INTRODUCTION

Mitigation and adaptation are said to be the two primary instruments of the international climate convention for minimizing the negative impacts of climate change on humans and ecosystems (Duguma *et al*. 2014, p. 420). However, a growing intensity of calls for more decision-oriented research has been evident in recent years, as priorities have moved from estimating impacts and vulnerabilities, so as to make the case for mitigation (Wise *et al*. 2014, p. 326). In most parts of Africa (most especially Yobe State, located in north-eastern Nigeria), climate change mitigation focusses on reforestation and forest protection (Mbow *et al*. 2014, p. 8). Whereas; tested strategies for promoting individual actions to mitigate climate change have been explored extensively, such as showing students how to make use of public transit, rather than simply encouraging it (Cornelius *et al*. 2014). But before these strategies can be widely implemented in classrooms as

clarified by some researchers, there must be an accurate information that will give priority to actions in the curriculum, documents and teaching materials such as textbooks (Wynes & Nicholas 2017, p. 7). It has been observed that the rapidly growing significance of cities in the developing world, and their sustained prominence in the developed world, has profound implications for the mitigation of climate change (Gouldson *et al*. 2015, p. 94). Hence, climate change is projected to impact the human and natural systems, with differential consequences across regions, economic sectors, and time. Similarly, the magnitude and extent of future impacts depends not only on the dynamic forces of the earth system, but also on socio-economic developments (Van Vuuren *et al*. 2014, p. 374). The dire circumstances we have found ourselves today at the study area with regards to climate change mitigation is what led to this research, in order to find out if at all the residents at the study area are aware of UNFCCC strategies and techniques for climate change mitigation, whether or not they believe that those strategies could be effective in mitigating CO_2 emission.

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MATERIALS AND METHODS

Description of the Study Area: Damaturu, the administrative capital of Yobe State is located between latitude 11° 44' N to 11° 45'N and longitude 11° 56' E to 11° 58' E (Emeka and Weltime 2008, p. 58). The State was delineated out of the old Borno State on the 27th of August, 1991. It covers an estimated area of 47,153km² and shares an international border with Niger Republic to the north, Jigawa and Bauchi states within the country to the west, Borno State to the east as well as Gombe State to the South (YSGN, 2014). Yobe State has hot and dry climatic condition in the northern part of the State for most part of the year. The southern part of the State, particularly the rocky area of Gujba and Fika Local Government Areas has a hotter and cooler condition for most part of the year. The month of March, April and May are the hottest months of the year with temperatures ranging from 39 – 42°C. The duration of rainy season varies in the State from one place to another; nevertheless, it generally lasts for almost 120 days in the North and more than 140 days in the South. Its annual rainfall ranges from 500mm - 1000m, and the rainy season usually falls from the month of June-to-September in the Northern part of the State, and May-to-October in the southern part of the State (YSGN, 2014).

The State has two vegetation zones, namely; the Sahel savannah in the northern part and the Sudan savannah in the southern part. The Sahel savannah has been severely threatened by desert encroachment, thus creating an arid and a semi-arid condition. The topography of the State is generally flat, except for the southern parts where the land is generally rocky. The northern parts of the State are generally flat with an undulating sand dune. One of the most important geographical features of the State is the river Yobe which the State derived its name from (YSGN, 2014). It has also been reported that; the West African Savannah-Sahel region has become synonymous with crisis and catastrophe, with images of dying trees, moving sand dunes, drying up of wetlands, and expanding swathes of unproductive land, which have become conventional in both popular and political discourse, that the situation in the Sahel as it often appears is a script already written, and that many people are merely waiting for the seemingly unavoidable calamities, and the incapability to take action in order to deter or cope with the course of events (Milligan and Binns 2007, p. 143).

Yobe State has an estimated population of around 2,321,591. Damaturu, its administrative capital is also estimated to be around 87,706. It has an average population density of 29.92 persons per km² and this varies from one local government to another. The pattern of population distribution in Yobe State can be categorised into three, namely; sparsely populated areas with a population density of less than 20 persons per km², moderately populated areas with a population density of 20 - 40 persons per km² and the densely populated areas with a population density of more than 40 persons per km² (NPC, 2009). Most densely populated areas are found in the west central part of the state, while the sparsely populated areas are found in the extreme northern part of the state (YSGN, 2014). The dependency ratio of the state is 92.4%, indicating a high population growth rate, and the age structure of the state is similar to the rest of Nigeria's population (NPC, 2009). The Age structure of Nigeria according to the world fact book is as follows; 0-14 years: 42.54% (male 41,506,288/female 39,595,720); 15-24 years: 19.61% (male 19,094,899/female 18,289,513); 25-54 years: 30.74% (male 30,066,196/female 28,537,846); 55-64 years: 3.97% (male 3,699,947/female 3,870,080); 65 years and over: 3.13% (male 2,825,134/female 3,146,638) based on 2017 estimate (World Factbook, 2018).

Methodology

Questionnaire: This research made use of a structured questionnaire (Qs.) to collect data. The Qs. is an extensively used and beneficial instrument for collecting survey information because it provides structured, every so often numerical data, being able to be administered without the researcher being there, and frequently being comparatively straightforward to analyse (Wilson and McClean, 1994) in (Cohen *et al.* 2007, p. 317).

Validation of the Survey Instrument (Qs.): In order to justify the quality of the questions contained in the Qs. It was then validated before been administered. Validity is been defined as the appropriateness, meaningfulness, and usefulness of a measure for a particular purpose. It is commonly seen as the most significant attention in the assessment of a measure (AERA, 1999) in (Jensen 2003, p. 346). Jensen (2003) stressed that; validity does not refer to whichever inherent characteristic of the measure, because measures themselves are never "valid" or "invalid." He clarified that; validity always needs to be assessed in relation to the uses of the measure (Jensen 2003, p. 346). A group of researchers have found out that; the personal delivery and collection of SAQ is evaluated in contrast with alternative methods of procurement of data from respondents. For long questionnaires, individual delivery by lightly-trained survey users appears to return higher response rates than mail surveys at an inexpensive cost. They have also observed that; it as well provides for more accurately controlled samples, and vibrant identification of the nature of non-response bias (Lovelock *et al.* 1976, p. 358). The final draft of the Qs. was highly scrutinised by peers, meetings and interviews were organised and held between the researchers and built environment professionals with more than 30 years working experience. The professionals are; architects, building engineers, civil engineers, surveyors, planners and others in order to have their expert views on the format of the Qs., scope and the questions contained therein, both at the study area and from the neighbouring states. This was done in order to know whether the questions were clear, comprehensible and in a logical order. 400 questionnaires (Qs.) were administered during the period of March, 2017 and September, 2018. Out of the 400 that was distributed, 305 completed Qs were returned, some were invalid and others were not returned.

Rating: This research has adopted the Rating scales as one way in which degrees of response, strength of response, and the move-away from dichotomous-questions have been coped with, can be grasped in the notion of rating scales such as the Likert scales. The Likert scale is a very valuable device for the researchers, as it constructs in a degree of sensitivity and variation of response while still creating numbers (Cohen *et al.* 2011, p. 386). The attractiveness of the Likert method comes from a number of facts such as; an easy construction of the Likert scale which can modified; the direct use for statistical inference of the numerical measurement; measurements founded on Likert scaling have established a good reliability. In general, with Likert scaling, researchers can collect and analyse a large quantity of data with a lesser amount of time and effort (Li 2013, p. 1609).

Coding: The UNFCCC strategies and techniques for climate change mitigation were coded in order to carry out their analysis using SPSS. The names of the respondents were also coded for discretion. Coding has been defined as the method of converting data obtained on a participant or unit into values which is usually in a numeric form, for the purpose of storing the data, reduction, management and analysis (Holosko and Thyer 2011, p. 18).

Table 1. Coding of the Strategies

S/N	UNFCCC strategies and techniques for climate change mitigation	SPSS Code
1	Renewable Energies	CCM_UNFCCC1
2	Making older equipment more energy efficient	CCM_UNFCCC2
3	Changing management practices or consumer behaviour	CCM_UNFCCC3
4	A plan for a new city	CCM_UNFCCC4
5	Improvements to a cook stove design	CCM_UNFCCC5
6	High-tech subway systems	CCM_UNFCCC6
7	Bicycling paths and walkways	CCM_UNFCCC7
8	Protecting natural carbon sinks like forests and oceans, or creating new sinks through silviculture or green agriculture	CCM_UNFCCC8

RESULTS AND DISCUSSION

"Renewable Energies" As a Strategy for Mitigating Climate Change: Out of 305 respondents that participated in the survey, 30 of them indicated that; the use of "renewable energies" as a strategy for mitigating climate change is "Very Ineffective", 12 indicated that it is "Ineffective", 26 were "Neutral", 134 thought it is "Effective", and 103 believed it is "Very Effective". See Figure 1.
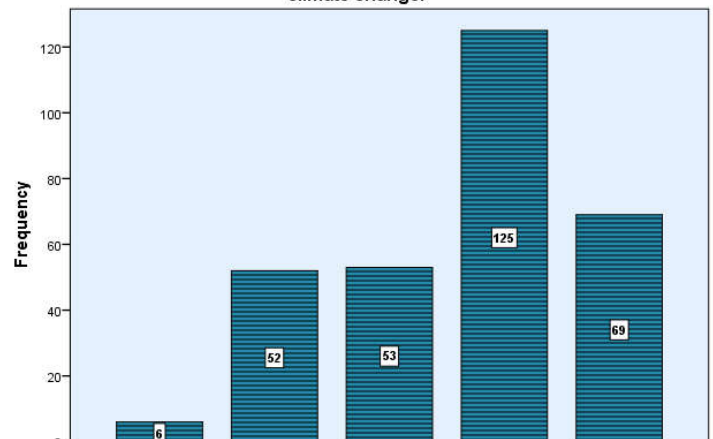
"Making Older Equipment More Energy Efficient" As a Strategy for Mitigating Climate Change: Out of 305 respondents that participated in the survey, 6 of them showed that; the use of "making older equipment more energy efficient" as a strategy for mitigating climate change is "Very Ineffective", 52 indicated that it is "Ineffective", 53 were "Neutral", 125 thought it is "Effective", and 69 believed it is "Very Effective". See Figure 2.

"Changing Management Practices or Consumer Behaviour" As a Strategy for Mitigating Climate Change
Out of 305 respondents that participated in the survey, 11 of them disclosed that; "changing management practices or consumer behaviour" as a strategy for mitigating climate change is "Very Ineffective", 20 indicated that it is "Ineffective", 35 were "Neutral", 139 thought it is "Effective", and 100 believed it is "Very Effective". See Figure 3.

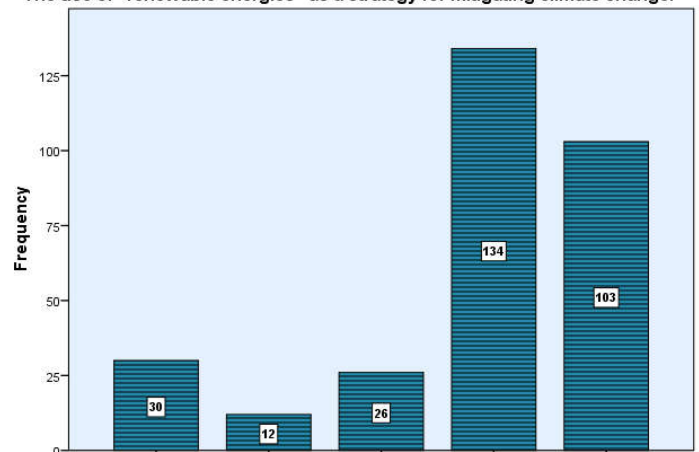**"A Plan for a New City" As a Strategy for Mitigating Climate Change:** Out of 305 respondents that participated in the survey, 19 of them revealed that; "a plan for a new city" as a strategy for mitigating climate change is "Very Ineffective", 36 indicated that it is "Ineffective", 53 were "Neutral", 110 thought it is "Effective", and 87 believed it is "Very Effective". See Figure 4.

"Improvements to a Cook Stove Design" As a Strategy for Mitigating Climate Change: Out of 305 respondents that participated in the survey, 14 of them disclosed that; "improvements to a cook stove design" as a strategy for mitigating climate change is "Very Ineffective", 21 indicated that it is "Ineffective", 33 were "Neutral", 133 thought it is

"Effective", and 104 believed it is "Very Effective". See Figure 5.
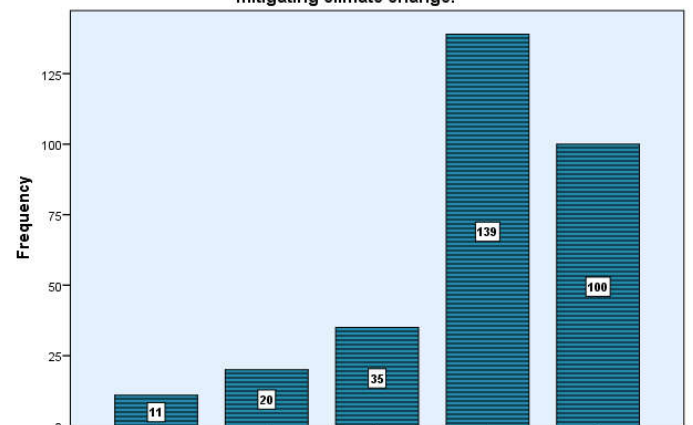

Figure 1.

Figure 2.

Figure 3.

"High-Tech Subway Systems" As a Strategy for Mitigating Climate Change: Out of 305 respondents that participated in the survey, 17 of them showed that; the use of "high-tech subway systems" as a strategy for mitigating climate change is "Very Ineffective", 17 indicated that it is "Ineffective", 62 were "Neutral", 153 thought it is "Effective", and 56 believed it is "Very Effective". See Figure 6.

"Bicycling Paths and Walkways" As a Strategy for Mitigating Climate Change: Out of 305 respondents that

participated in the survey, 21 of them revealed that; the use of "bicycling paths and walkways" as a strategy for mitigating climate change is "Very Ineffective", 30 indicated that it is "Ineffective", 76 were "Neutral", 119 thought it is "Effective", and 59 believed it is "Very Effective". See Figure 7.

Figure 4.

Figure 5.

Figure 6.

Protecting Natural Carbon Sinks Like Forests and Oceans, or Creating New Sinks Through Silviculture or Green Agriculture: Out of 305 respondents that participated in the survey, 17 of them indicated that; "Protecting natural carbon sinks like forests and oceans, or creating new sinks through silviculture or green agriculture" as a strategy for mitigating climate change is "Very Ineffective", 16 indicated that it is "Ineffective", 21 were "Neutral", 102 thought it is "Effective", and 149 believed it is "Very Effective". See Figure 8.
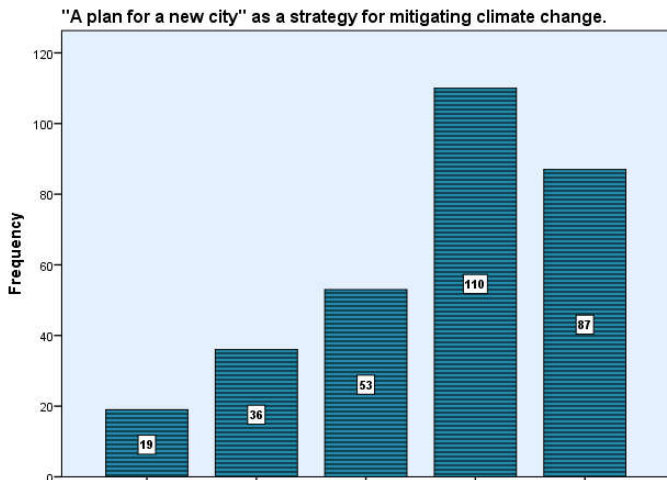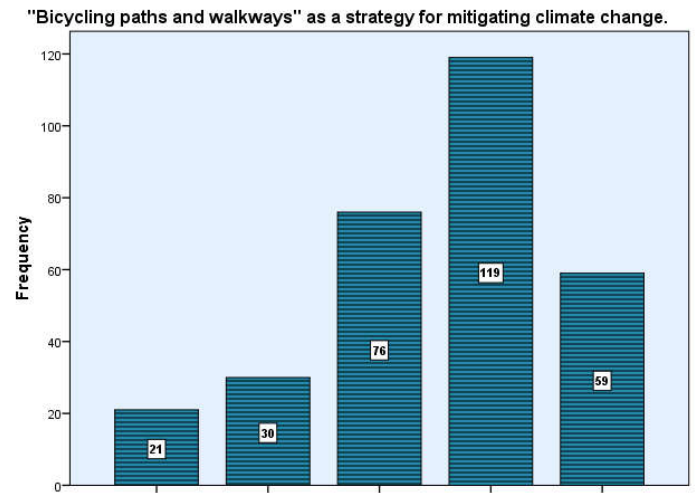

Figure 7.

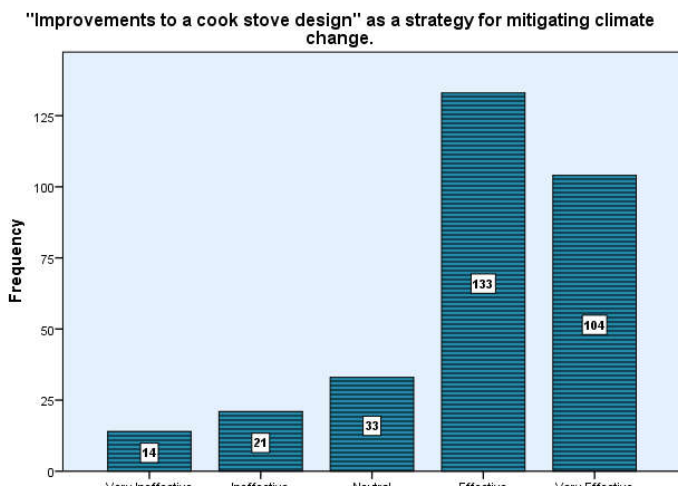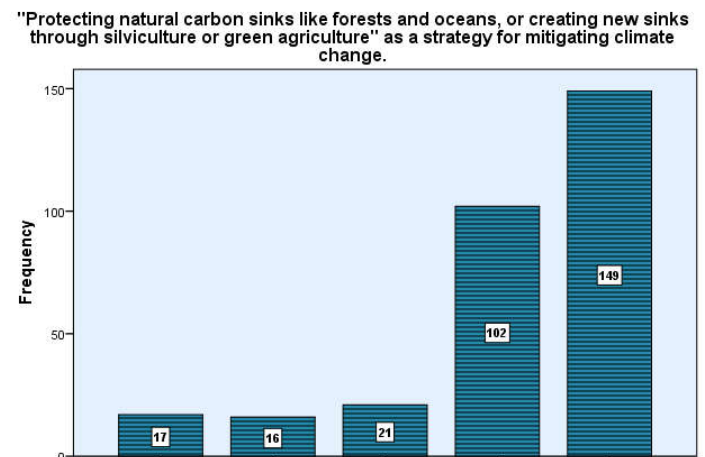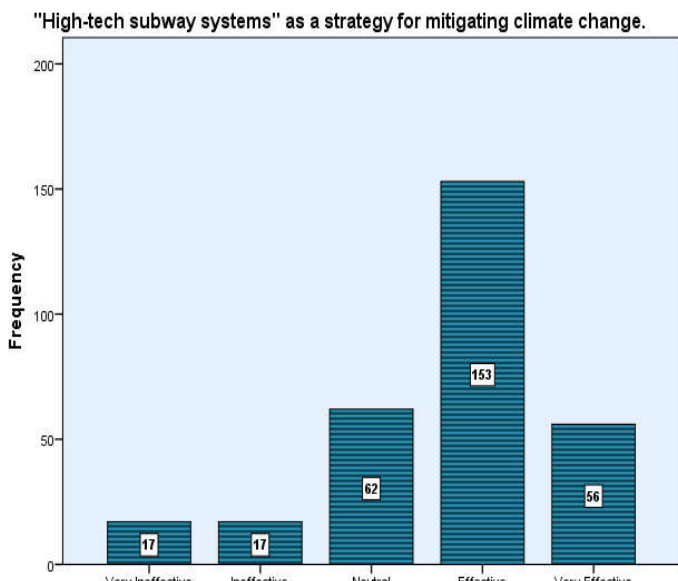**Figure 8.**

Conclusions

Niles *et al*. (2016) clarified that; there is evidence across a wide range of disciplines that human intention to do something does not always show that they will. He suggested that; it is imperative to better assess and empirically understand why such discrepancies exist and what aspects influence intention and actual behaviour. He further reiterate that; for an issue like climate change, it is particularly timely because numerous policies and programs are being implemented and accurate understanding of what influences real change in behaviour is useful for effective design (Niles *et al*. 2016). Some residents at the study area seems oblivious of what is happening around the world with regard to climate change mitigation. There is still a steady increase of tree cutting (evergreen trees); bush burning; unplanned and unrestricted clearing of land for agricultural purposes; sporadic real estate development; an improper disposal of toxic solid and liquid waste; an

unrestrained incineration of refuse; ignored toxic emissions from motor cycles, rickshaws (popularly known as Keke NAPEP), emission from other non-roadworthy vehicles such as; cars, buses and trucks. To compound the state of affairs, most residents at the study area are already physically exposed to the Impact of the Emerging Climate Change Risks (Maina-Bukar *et al.* 2015) in one way or the other, coupled with the psychological trauma associated with everyday living at a region where temperature reaches 42 – 51ºC, where most residents live below the poverty line, where human and animal rights is partially in the interest of policy makers. These circumstances are enough to trigger a mass exodus by those afflicted with such occurrences. Yet, some of these residents are not bothered and remain patiently calm with the conditions they find themselves in. Climate change mitigation is an intriguing subject to investigate. In addition, it is equally significant to find out and understand why people easily give-up on nature, why the residents at the study area do not take extra measures to make their lives more 'liveable', why they are abandoning age-old measures that have sustained them for generations and having this 'newfound affinity' towards anything that glitters. The residents at the study area have heard all sort of promises made by policymakers, Non-Governmental Organisations (NGO's), wealthy individuals and corporations since 70's. They have initially welcomed these intervention with scepticism and less hope, knowing the kind of people who supervise, lead or govern them. The iota of their optimism later turned to disappointment because till date, no major intervention programme has fully taken-off. Promises have been made with regards to improving the lives of these residents and the environment as a whole, some of the intervention measures, policies and programmes initiated and carried-out have recorded a noteworthy amount of success, while some remain vague and seems more like a 'white elephant project'. As academicians, policymakers and stakeholders, we must not relent in seeking for state-of-the-art measures of curtailing the impact of whatever threatens our very existence. At the same time, we must be honest with ourselves and reveal to the entire world whether or not we truly belief in the climate change cause, a prerequisite in making the strategies work.

REFERENCES

AERA (American Educational Research Association), American Psychological Association, National Council on Measurement in Education, Joint Committee on Standards for Educational, & Psychological Testing (US). 1999. *Standards for educational and psychological testing.* Amer Educational Research Assn.

Cohen, L., Manion, L., & Morrison, K. 2007. Research Methods in Education. Taylor & Francis e-Library, 2007. Routledge.

Cohen, L., Manion, L., & Morrison, K. 2011. Research Methods in Education [7th edition] Routledge. 2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

Commonwealth Governance (2018). Map of Nigeria. Geography of Nigeria (Online) Available at: http://www.commonwealthgovernance.org/countries/africa/nigeria/geography/[Accessed on: 27th September, 2018]

Duguma, L. A., Minang, P. A., & van Noordwijk, M. 2014. Climate change mitigation and adaptation in the land use sector: from complementarity to synergy. *Environmental management,* 54(3), 420-432.

Emeka, D. O., & Weltime, O. M. 2008. Trace elements determination in municipal water supply in Damaturu Metropolis, Yobe State, Nigeria. *Bayero Journal of Pure and Applied Sciences,* 1(1), 58-61.

Gouldson, A., Colenbrander, S., Sudmant, A., McAnulla, F., Kerr, N., Sakai, P., &Kuylenstierna, J. 2015. Exploring the economic case for climate action in cities. *Global Environmental Change*, 35, 93-105.

Holosko, M. J., & Thyer, B. A. 2011. *Pocket glossary for commonly used research terms.* SAGE.

Jensen, M. P. 2003. Qs. validation: a brief guide for readers of the research literature. *The Clinical journal of pain*, 19(6), 345-352.

Li, Q. 2013. A novel Likert scale based on fuzzy sets theory. *Expert Systems with Applications,* 40(5), 1609-1618.

Lovelock, C. H., Stiff, R., Cullwick, D., & Kaufman, I. M. 1976. An evaluation of the effectiveness of drop-off questionnaire delivery. *Journal of Marketing Research*, 358-364.

Maina-Bukar, Y., Boussabaine, H., & Ahmed, A. 2015. Coming to terms with reality: the Impact of the Emerging Climate Change Risks (IECCR) on Sustainable Urban Growth in Damaturu. *Journal of Civil Engineering and Environmental Technology.* Print ISSN: 2349-8404; Volume 2, Number 4; April-June, 2015 pp. 339-344

Mbow, C., Smith, P., Skole, D., Duguma, L., & Bustamante, M. 2014. Achieving mitigation and adaptation to climate change through sustainable agroforestry practices in Africa. *Current Opinion in Environmental Sustainability,* 6, 8-14.

Milligan, S., & Binns, T. 2007. Crisis in policy, policy in crisis: understanding environmental discourse and resource□use conflict in northern Nigeria. *The Geographical Journal,* 173(2), 143-156.

Niles, M. T., Brown, M., & Dynes, R. 2016. Farmer's intended and actual adoption of climate change mitigation and adaptation strategies. *Climatic Change,* 135(2), 277-295.

NPC 2009. Federal Republic of Nigeria Official Gazette. N0.2 Abuja – 2nd February, 2009 Vol. 96. The Federal Government Printer, Abuja Nigeria. FGP 16/22009/10,000(0L02)

Van Vuuren, D. P., Kriegler, E., O'Neill, B. C., Ebi, K. L., Riahi, K., Carter, T. R., ... & Winkler, H. 2014. A new scenario framework for climate change research: scenario matrix architecture. *Climatic Change,* 122(3), 373-386.

Wilson, N., & McClean, S. I. 1994. *Qs. design: a practical introduction.* Coleraine: University of Ulster.

Wise, R. M., Fazey, I., Smith, M. S., Park, S. E., Eakin, H. C., Van Garderen, E. A., & Campbell, B. 2014. Reconceptualising adaptation to climate change as part of pathways of change and response. *Global Environmental Change*, 28, 325-336.

World Factbook 2018. Africa. Nigeria. Age Structure (Online) Available: https://www.cia.gov/library/publications/resources/the-world-factbook/geos/ni.html [Accessed on: 27th September, 2018]

Wynes, S., & Nicholas, K. A. 2017. The climate mitigation gap: education and government recommendations miss the most effective individual actions. *Environmental Research Letters,* 12(7), 074024.

YSGN, 2014. About Yobe State - Yobe State Government of Nigeria [Online] Available at: http://www.yobestategov.com/[Accessed on: 3rd March, 2014]

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